

**WHAT IS CLAIMED IS:**

1. An automatically scramming nuclear reactor system, comprising:
  - a core, said core having a coolant inlet end and a coolant outlet end;
  - a cooling system operatively associated with said core, said cooling system providing coolant to the coolant inlet end of said core and removing heated coolant from the coolant outlet end of said core, said cooling system maintaining a pressure differential between the coolant inlet end of said core and the coolant outlet end of said core during a normal operating condition of said nuclear reactor system;
  - a guide tube positioned adjacent said core, said guide tube having a first end and a second end, the first end of said guide tube being in fluid communication with the coolant inlet end of said core, the second end of said guide tube being in fluid communication with the coolant outlet end of said core; and
  - a control element positioned within said guide tube, said control element being movable within said guide tube between an upper position and a lower position, the control element automatically falling under the action of gravity to the lower position when the pressure differential drops below a safe pressure differential.
2. The nuclear reactor system of claim 1, wherein said control element comprises a piston body, said piston body being closely received within said guide tube, said piston body being held above the lower position within said guide tube primarily by a static pressure component of the pressure differential.
3. The nuclear reactor system of claim 1, wherein said control element comprises an aerodynamic body, said aerodynamic body being loosely received within said guide tube, said aerodynamic body being lifted above the lower position within said guide tube primarily by a dynamic pressure component of a bypass flow of coolant in said guide tube.

4. A method for scramming a nuclear reactor system, comprising:  
providing a coolant to a core of said nuclear reactor system;  
removing heated coolant from the core of said nuclear reactor system, providing coolant and removing heating coolant establishing a flow of coolant through said nuclear reactor system, the flow of said coolant providing a lift force during a normal operating condition of said nuclear reactor system;  
using the lift force provided by the flow of said coolant to hold a control element above a scramming position during the normal operating condition of said nuclear reactor system, the control element automatically falling under the action of gravity to the scramming position when said nuclear reactor system exceeds a safe operating temperature.
5. The method of claim 4, wherein using the lift force to hold a control element above a scramming position comprises using primarily a static pressure component of the pressure differential to hold the control element above the scramming position.
6. The method of claim 4, wherein using the lift force to hold a control element above a scramming position comprises using primarily a dynamic pressure component of a bypass flow of coolant to hold the control element above the scramming position.
7. The method of claim 4, wherein said step of providing a coolant comprises providing a coolant in a gas phase.